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MASS DEPOSITION OF COMPLETELY RESOLVED SAMARIUM ISOTOPES

by

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A continuation of the experiments with the new positive ion source,* which employs a tungsten crucible surrounded by a tungsten loop filament for heating and ionizing the material within the crucible, has shown that it is suitable for producing microgram quantities of completely resolved isotopes. Electronic stabilizer circuits have been added to control both the electron bombarding voltage between the tungsten filament and the crucible and the electron emission current from the filament to the crucible.

It was found that uniform deposits could not be built up on ordinary metallic surfaces because of the tendency to sputter under ion impact. Successful deposits were obtained with a system of rectangular metallic cups, of about the same open area as the individual isotope beams, and deep enough to suppress the loss by sputtering. As an example of a typical deposit laid down in such a cup system, about 60 milligrams of Sm_2O_3 were melted in a tungsten crucible having a tantalum cap with a 1 mm hole in the axis. The melted Sm_2O_3 formed a glass-hard mass. The crucible thus prepared was placed in the source in the spectrograph which was provided with a 0.250 mm slit formed by two jaws of pure tungsten, 0.125 mm thick. This slit withstood for several hours the intense bombardment of a positive ion beam of 8,500 volts emerging from the source.

The ion beam was monitored by a collector at the Sm^{154} line. With a bombarding voltage of 700 volts, an emission current of 0.175 ampere, and an ion accelerating voltage of 8,500 volts, the average intensity at Sm^{154} was 3×10^{-8} ampere and 12.9×10^{-8} ampere in all the isotopes. These currents may be raised by a factor of 10 by increasing the electron power put into the crucible. The total elapsed time for this deposit was 215 minutes. This corresponds to a mass of 2.65 micrograms. By recharging the crucible it was found possible to build up a total deposit of about 5 micrograms of completely resolved isotopes of Sm.

Although very poor deposits were collected on ordinary metal surfaces, it was found possible to collect good deposits on a plate of pure aluminum whose surface had been microblasted with a water suspension of 325-mesh vermiculite under a pressure of 70 psi. A photograph of such a deposit whose mass is approximately 0.9 microgram for the Sm isotopes, is shown in Figure 1. This was obtained under essentially the same conditions as the previous deposit except that the exposure time was 108 minutes and the ion accelerating voltage was 8,000 volts. Figure 1 shows that in the case of samarium, the oxide as well as the metal ions are deposited.

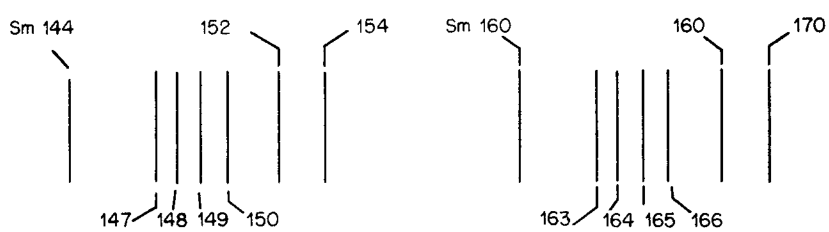

Figure 1. Mass deposits of the first order isotopes of Sm and SmO.

*Phys. Rev. 73:1222 (1948).